

Evidence of the holistic impact of classroom design on pupils' performance

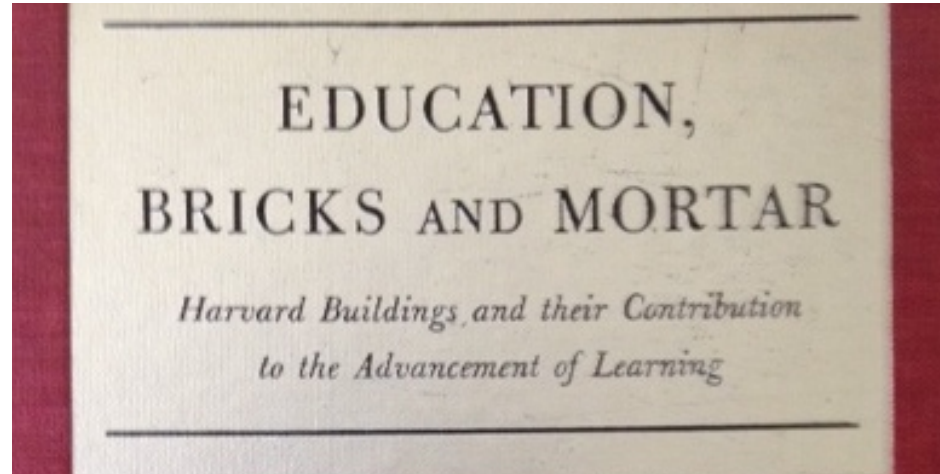
APPG Education, 9 February 2016

Professor Peter Barrett
Dr Lucinda Barrett, Dr Fay Davies, Dr Yufan Zhang
University of Salford

Questions addressed

- What was the problem?
 - What was the Aim / focus of the study?
- How were the challenges met?
 - How was a holistic view taken?
 - How were confounding factors controlled out
- What is the impact of school design on learning?
- Which design factors are significant?
 - What surprises were there?
- What are the practical implications?

**We all know
buildings make
a difference ...**



Partial studies of factors involved x Complex interaction of issues



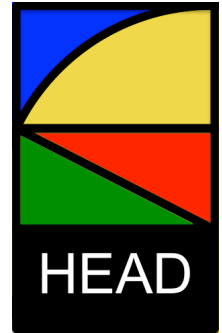
**But there is no
objective
evidence for the
impacts**

Physical environment

Very low or no impact for low cost based on very limited evidence.

The HEAD Project

Holistic Evidence and Design – sensory impacts, practical outcomes



To explore if there is any evidence for demonstrable impacts of school building design on the learning rates of children in primary schools

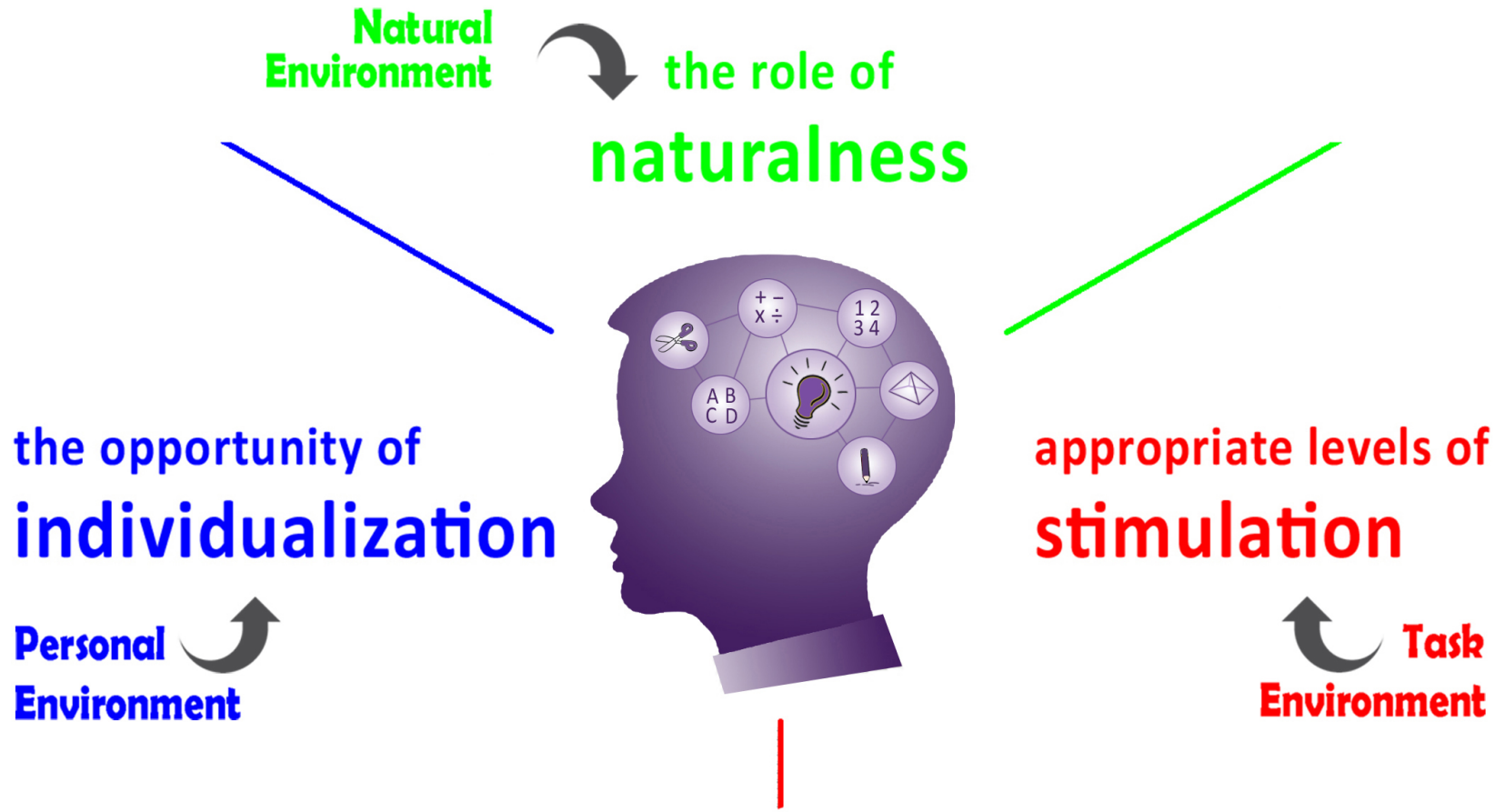
Primary schools present a real opportunity as pupils mainly in one space and there are annual measures of academic progress – relatively **simple**

*Pilot phase funded by Nightingales now IBI
HEAD Project funded by EPSRC 2012-15*

How was a holistic view taken?

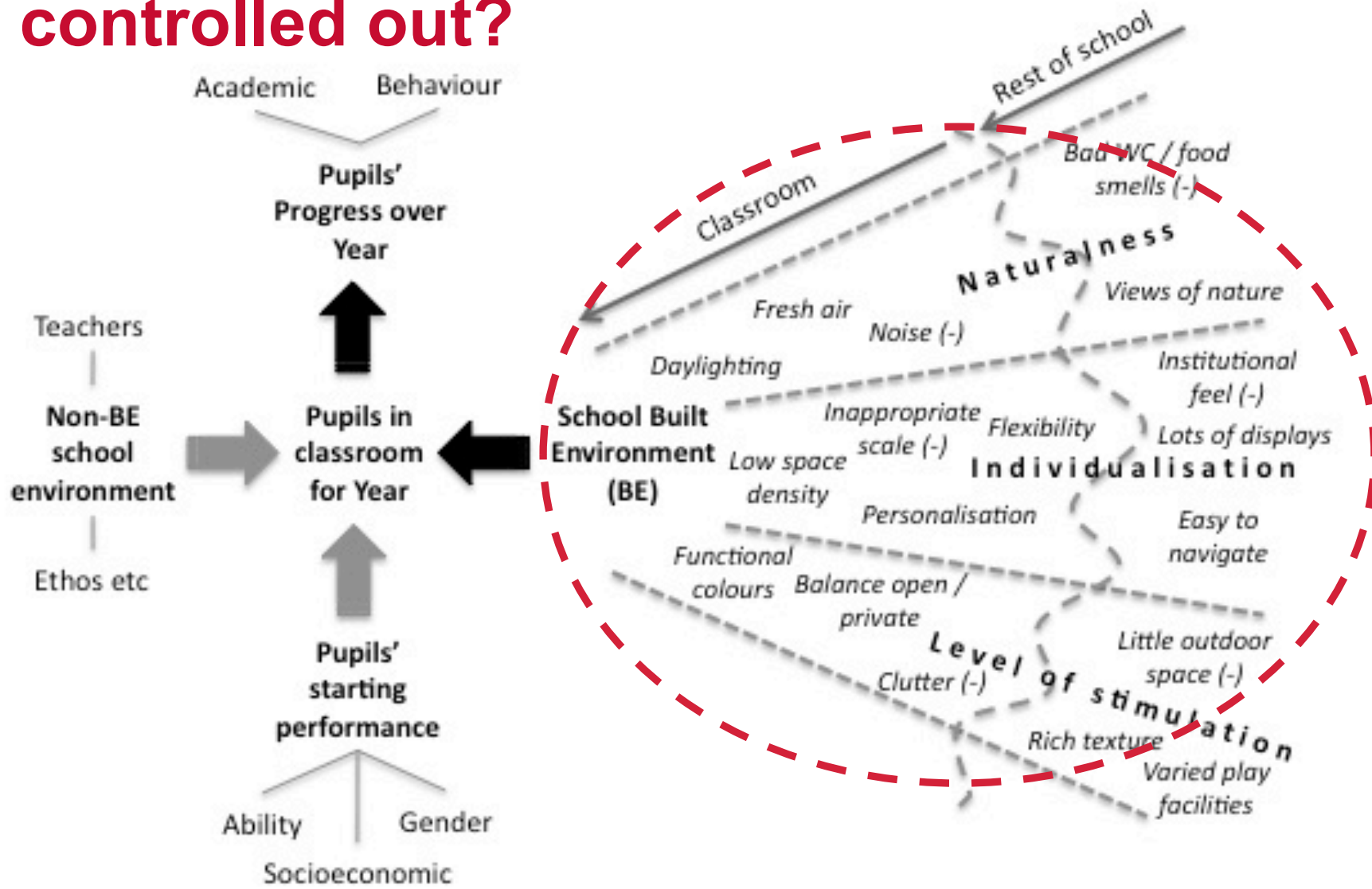


The SIN design principles



P. Barrett and L. Barrett (2010). "The Potential of Positive Places: Senses, Brain and Spaces". *Intelligent Buildings International*, 2: 218-228.

How were confounding factors controlled out?



In nested situations (pupils in classroom) **multilevel modeling** presents the opportunity to separate out impacts from various levels

Broad pupil comparisons

eg Hants v rest

	Area	
	Other	Hampshire
FSM	25.5%	13.9%
EAL	37.8%	2.0%
SEN	20.8%	13.3%
Total number of pupils	2231	1535



Taken into
account
through MLM

Big / diverse study sample

Looked at 153
classrooms in
27 schools,
3766 pupils

- **Observation** – layout, display, lightings, floor covering, colour, view out, window (opening) size and position etc.
- **Measurement** – lighting level, temperature, noise level and CO₂ level, room height, window height, furniture and fixture size
- **Interview** – sensory comfort, e.g. temperature, glare, noise, smell, size and usage etc.



1900s



1920s



1950s



1970s




2000s

Results of Classroom level analysis

Parameters	Correlation	for Overall Improvement
Light	.159**	0.141
Sound	.042**	
Temperature	.105**	0.083
Air Quality	.122**	0.112
Links to Nature	.153**	
Ownership	.145**	0.078
Flexibility	.153**	0.115
Connection	.131**	
Complexity	.181**	0.085
Colour	.177**	0.074


Bivariate
analysis


Multilevel
modeling

*What is the impact of
school design on
learning?*

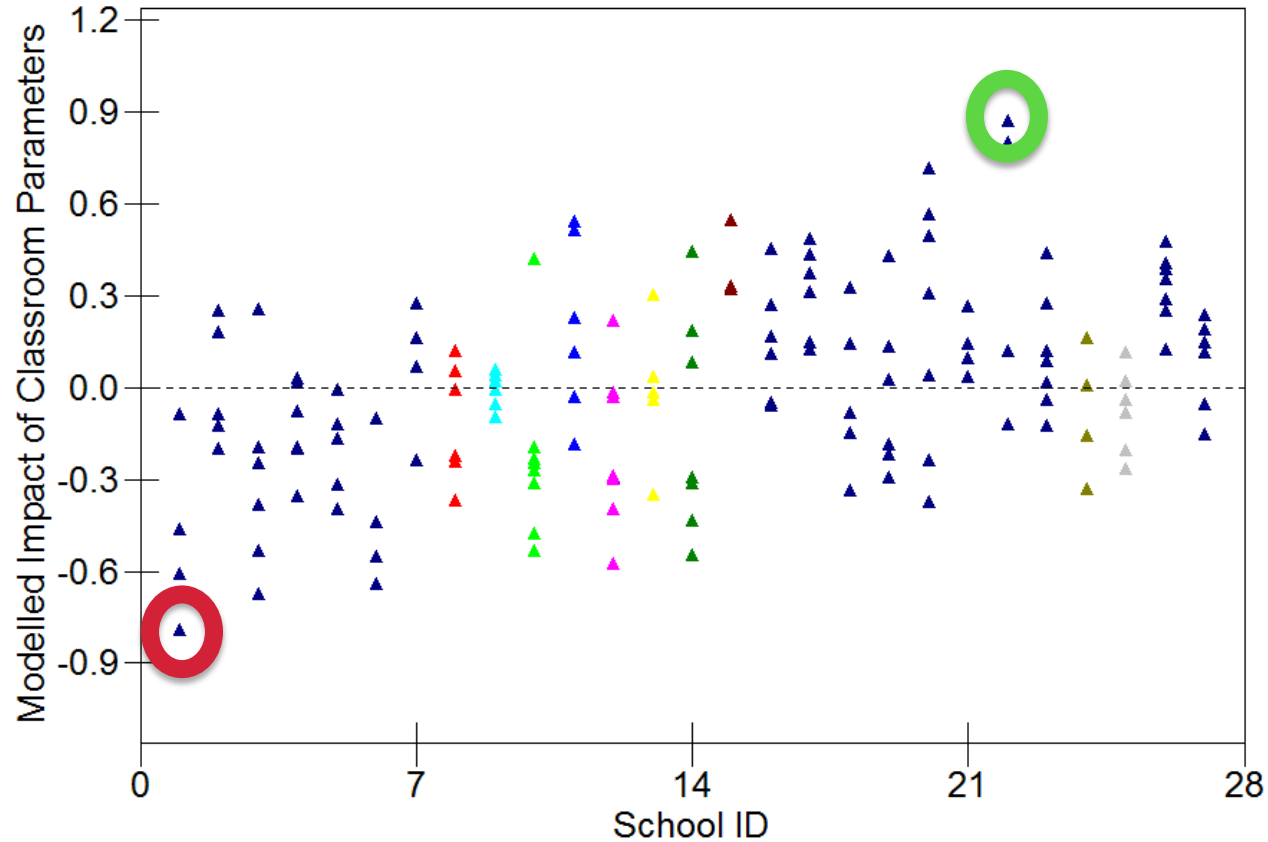
Headline results

The SIN principles explain **16%** of
the variation in learning achieved by
the pupils over a year

(Using National Curriculum sublevels in Reading, Writing
and Maths at the start and end of the year, and fixing all
except built environment factors to their means)

Multilevel
modelling
factored out
other
influences

Extreme case - potential impact



Least
effective
classroom

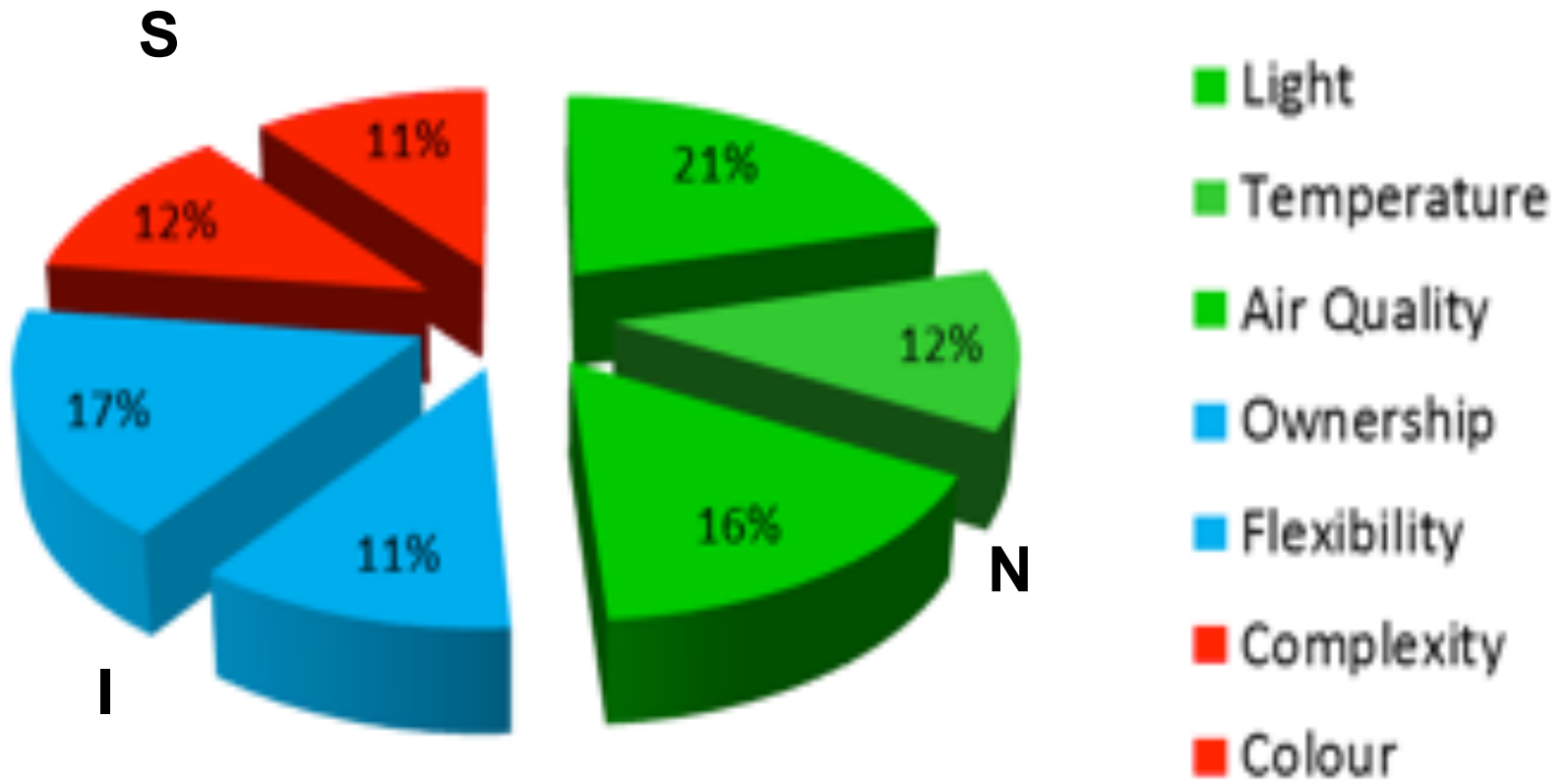


Most
effective
classroom

+ 1.3 sublevels for
“average pupil”

*Which design
parameters are
significant?*

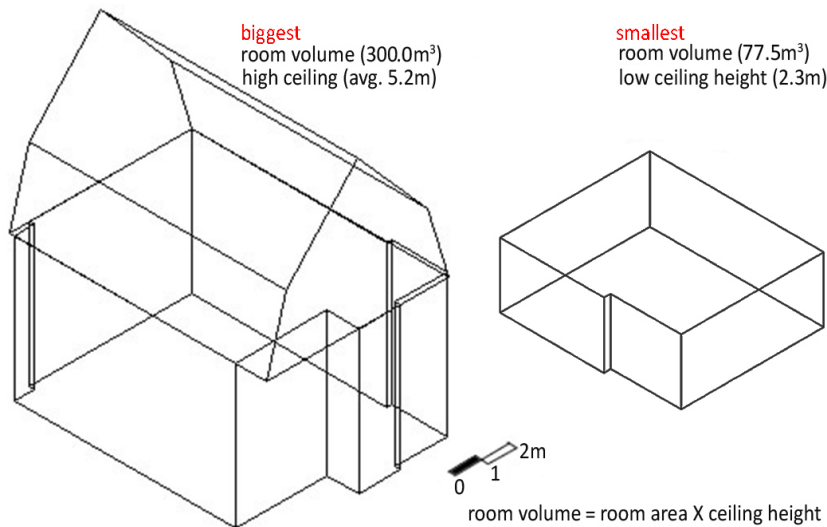
Contribution from each classroom measures



Some parameters illustrated

Naturalness: Air quality

- Large, varied openings good, especially at high level
- Can clash with roller blinds
- Large room volume can help

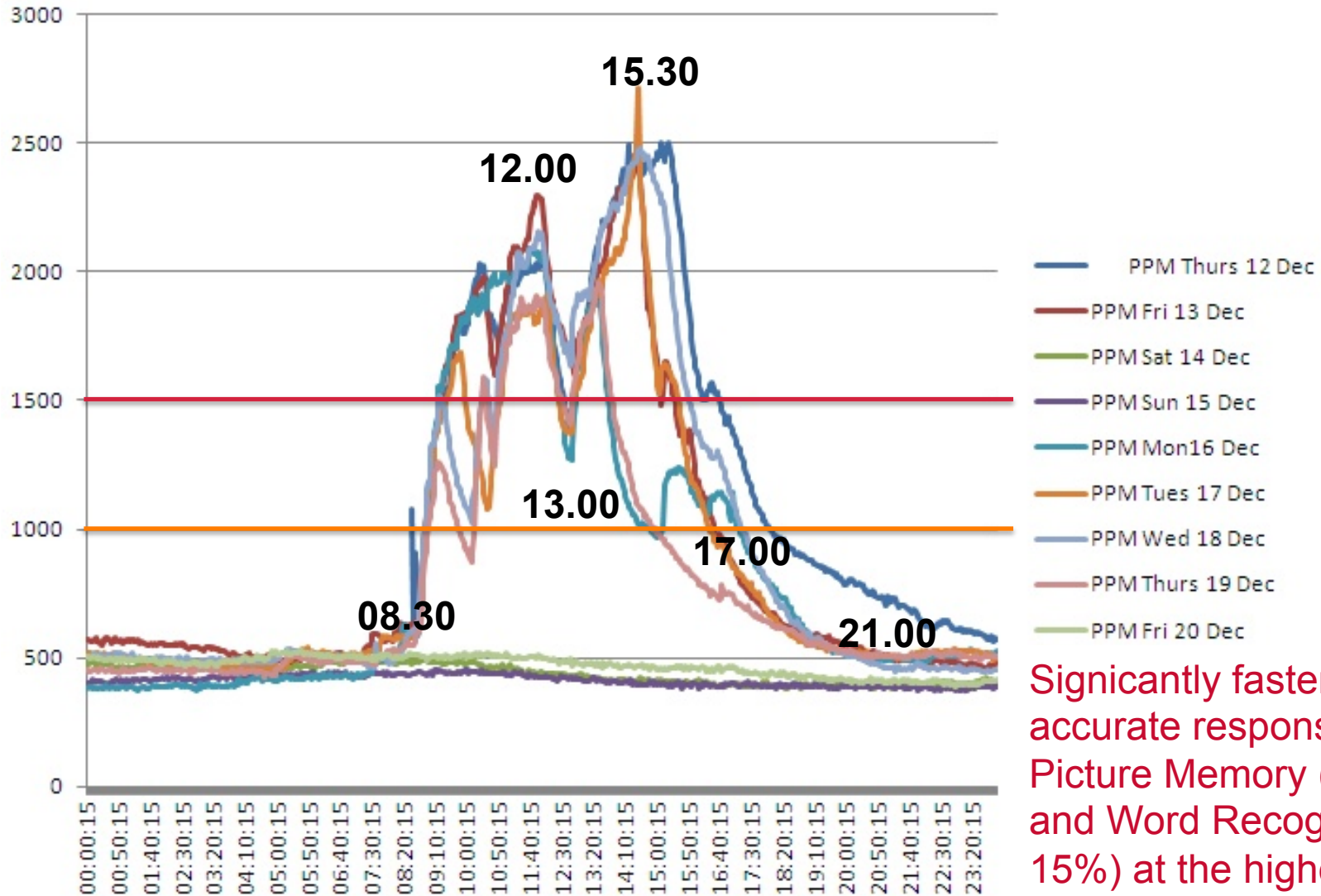


Average time for a
class of pupils to
“create” poor air
quality ... ?

30
minutes

CO₂ in one classroom over a week

An example



Significantly faster and more accurate responses for Picture Memory (by 8%) and Word Recognition (by 15%) at the higher ventilation rates

Individualisation: Ownership

A range of factors were found to be important in two categories: aspects that helped pupils identify with “their” classroom; and aspects that are child-sensitive.

- Distinctive room design
- Pupils’ work is displayed on the walls. Other elements such as shared display tables.
- Elements that are personalized by the pupils: such as coat pegs, lockers and / or named drawers.
- Well-designed furniture that creates a learning space that is child centred.
- Desks and chairs that are comfortable, interesting and ergonomic to the pupils’ ages and sizes.



class-made display



personal storage



lots of class-made art work on display in varied formats and sizes.

Level of stimulation: Complexity

Which is good?



TOO LITTLE



ABOUT RIGHT



TOO MUCH

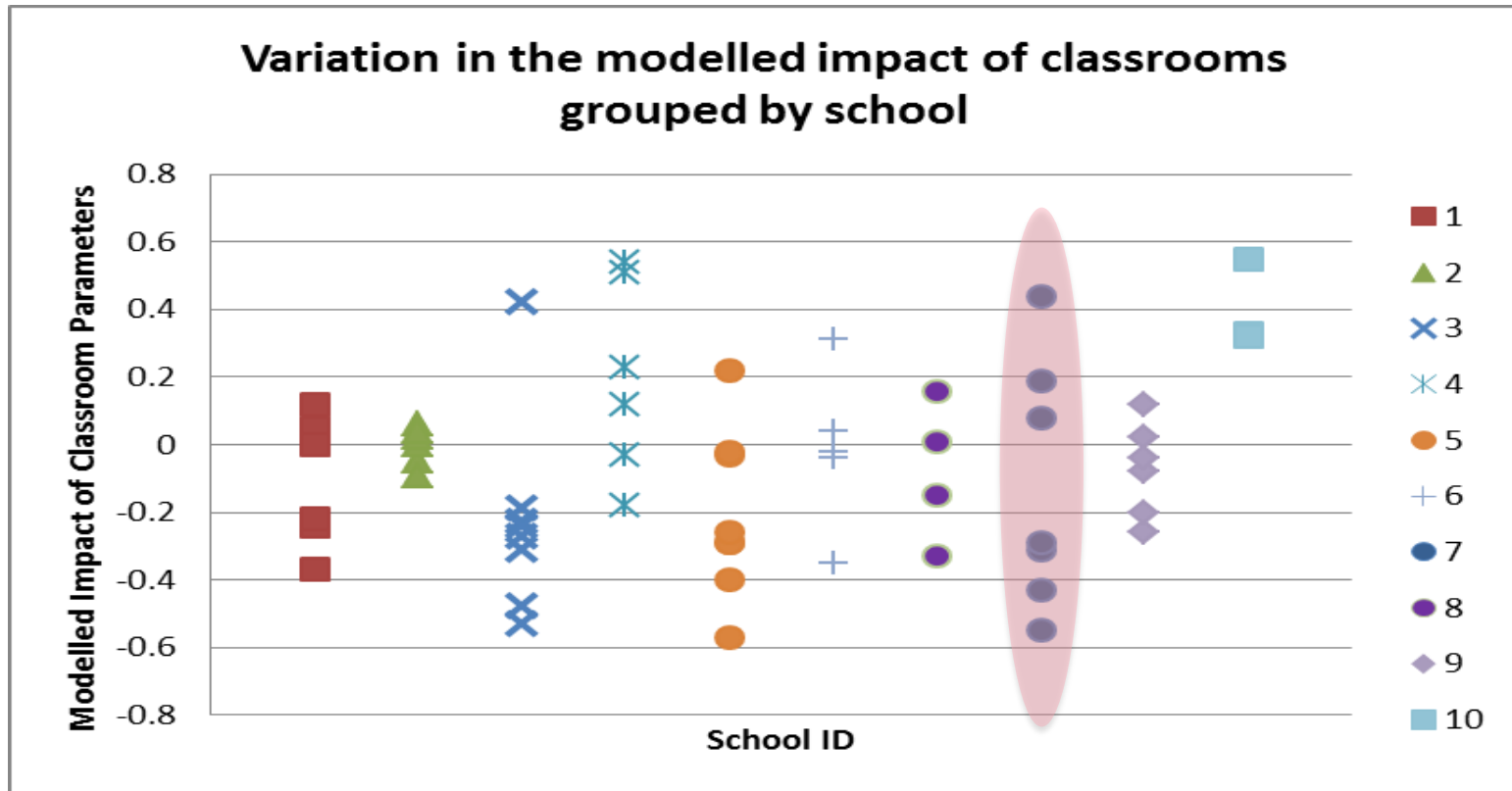
Appropriate level of stimulation is
curvilinear for learning – not too
exciting, not too boring

What surprises were there?

- The muted effect of “school” level factors

School Level Factor	Measures
School Naturalness	Outside Learning zones, Play ground Area
School Individualisation	Site area, Building floor area, Number of pupils
School Stimulation, Appropriate level of	Building Façade, Complexity of layout, Alternative learning rooms

Big variations *within* schools



First and foremost the individual classrooms must each be well designed – **argument for “inside-out design”**

The importance of the classroom

North facing
on this side



South facing
on this side

Differences by subject / pupils were found Current analyses

- **Reading** – “connection” becomes significant: “corridor libraries”, especially for **FSM** pupils. “Level of stimulation” has increased salience.
- **Writing** – “links to nature” becomes significant: relationship to creativity? “Level of stimulation” has increased salience.
- **Maths** – “individualisation” dominant: link to confidence issue in this subject?
- **SEN** – “light” (glare?) and “level of stimulation” (colour) dominant and overall impact rises to 19%.

Practical implications

- The HEAD results open up the possibility to:
 - Focus on the **key aspects** of school building design / use ...
 - So, maximising **positive** elements that support pupils' **learning** ...
 - Many **don't** have to cost lots of money and can be done **now**
 - And where it does cost money the results can inform the **optimal** allocation of resources.
- This is highly relevant for:
 - Teachers
 - Designers
 - Policy-makers

Outputs *freely* available:

- The “Clever Classrooms” illustrated report with practical suggestions for teachers and designers as a pdf at <http://ow.ly/Jz2vV>
- The underpinning *Building and Environment* journal paper at <http://dx.doi.org/10.1016/j.buildenv.2015.02.013>

Lot of interest – evidence helps!

- Schools conferences – teachers
- UK Department for Education; Welsh Constructing Excellence; Scottish Department of Education
- BBC Newsround
- Australian educational network (ACER)
- Norwegian Education Directorate
- US – ANFA (architecture and neuroscience network); USGBC; AIA
- OECD
- World Bank

I hope you find something of **interest** here that
can have a **positive** impact on the
educational experience of our children!

